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ABSTRACT

Patterns of learning by five infants with Down's syndrome (3.5 to 12.5 months old) were studied. The children were visited at home 2 to 3 times per week for periods ranging from 1 to 8 months. Two of the children were reinforced for pulling a string attached around their wrist. Consequences included tape recordings of music or their mother's voice, a colored light, and other stimulating materials. The type of reinforcement was changed when the response fell below the baseline rate. The other three infants were reinforced for kicking. Visual attention and responses to the manipulands and consequence were recorded. After the child had achieved a stable rate of responding on the operative response, the contingencies were reversed. All of the children showed rapid differentiation of the reinforced pulling response from the nonreinforced kicking response. However, the reinforced kicking response showed rapid differentiation only for the two children who learned the arm response first. These data suggest that the establishment of the generalized expectancy of control over the environment is more efficient if one begins with contingencies for movements which are most "prepared" for the individual child. Overall, the results suggest that handicapped children under 1 year of age can learn through simple contingencies of reinforcement. However, the patterns of acquisition appear to be somewhat different for different children. (SEW)

Patterns of Learning by Handicapped Infants

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For a number of years it has been suggested that infants with known developmental delays might benefit from early experiences with contingencies of reinforcement (Lewis & Goldberg, 1969; Watson & Ramey, 1972). However, the systematic application of such contingencies to handicapped infants has not been widespread (Robinson & Robinson, 1978; Watson, Hager & Vietze, in press). Instead, early intervention efforts have generally focused on teaching skills selected from an ever expanding array of developmental checklists (Brinker & Chatelanat, in press; Hogg, 1975: Switzky, Rotatori, Miller, & Freagon, 1975). The method for teaching these skills relies by and large upon use of social and tangible consequences with presumed reinforcing value. These methods have not produced dramatic behavioral changes in handicapped infants which would be evidence of learning versus maturation.

There are two major reasons for this lag of a decade between the practical application and the early suggestions that reinforcement contingencies influence subsequent learning and motivation in infancy. The first is that the technology necessary for arranging a variety of immediate consequences contingent upon a variety of simple responses is of necessity very cumbersome. The second problem has been that much of the evidence on infant learning has been obtained in the context of group designs involving a relatively large number of subjects (Brassell & Kaye, 1974; Caron, Caron & Caldwell, 1971; Millar, 1972; Rovee & Fagan, 1976; Siqueland, 1968). Although techniques for studying individual infant's behavior have been available (Sheppard, 1969; Sidman, 1960), these techniques have not played a large part in the study of normal infants' learning ability.

In recent years, the development of microcomputer technology has greatly reduced the size of a unit capable of complex logical programming and data storage. Thus, the large racks of programming logic and relays traditionally characteristic of learning laboratories may no longer be necessary. However in order to have a

variety of responses from which to select and in order to provide a variety of feedback a certain amount of technological complexity is still necessary. This is especially true if early learning experiences are individualized so that "prepared" (Seligman, 1970) responses can be selected and functional reinforcers can be found.

However, the technology and experimental designs are now available for providing early learning experiences to handicapped infants. The rationale for such experiences is much the same as that expressed over a decade ago (Lewis & Goldberg, 1969: Watson, 1966). Handicapped infants may be at risk for "learned" helplessness" for two reasons: one biological and one social. First, because of delays in motor development the handicapped infant has a prolonged period during which a very limited number of environmental events can be produced by a limited number of motor movements. Thus the handicapped infant may be exposed to a long period of contingency deprivation. A secondary effect of such a history would be that handicapped infants learn that their behavior does not influence the important events in their lives.

Secondly, the handicapped infant's social system is often primed to have reduced expectations regarding the infant's developmental potential (Affleck, 1980). If parents are led to believe that early experiences will have no impact on their child then they are likely not to respond contingently to their infant's actions. Mother responsivity has been shown to be positively related to later infant development (Lewis & Coates, 1980). The absence of such responsivity would be likely to have negative developmental consequences.

Early experience with contingencies of reinforcement should a) increase the infant's interest in and mastery of the environment; b) convince parents that their handicapped infant can in fact learn.

The Institute for the Study of Exceptional Children at Educational Testing Service has been developing a system for providing simple learning experiences to handicapped infants in their homes. The system is built around an APPLE II microcomputer so that children's performance can be analysed immediately and so that contigencies of reinforcement can be changed easily and efficiently. The system enables us to transduce simple movements by the infant so that they provide consistent feedback for such movements.

The purpose of this study was 1) to demonstrate learning by handicapped infants and 2) to examine the different patterns of acquisition during the learning process.

METHOD

Subjects. Five developmentally delayed infants were visited in their homes for a period of from 4 to 24 weeks. The children's pseudonyms, medical condition, chronological and mental age at initial contact are presented in Table 1.

Procedure. Children were visited in their homes two to three times per week for periods ranging from one to eight months. Rosa and Jennifer were reinforced for pulling a string attached around their wrist. Consequences included tape recordings of music or their mother's voice, a mechanical train which played a tune, a colored light, or a photographic slide. Generally only one type of consequence was available within a session except in some sessions during which the arm response fell below the baseline rate. In those sessions the type of reinforcement was changed at the point at which the response fell below the baseline rate.

Hugh, Juliet and Troy were reinforced for kicking. Consequences were selected from the range of events listed above and were individually determined for each child.

Table 1

Contingency Intervention Project Subject Roster

Child's Name	Medical Condition	Initial Contact Age	Initial Contact Mental Age	Follow Up Age	Follow Up Mental Age	Number of Sessions Leg	Number of Sessions Arm
Rosa	Down's Syndrome	6.0 ms	----	10 ms	----	10	7
Jennifer	Down's Syndrome	3.5 ms	2 ms	10.5 ms	9 ms	10	9
Troy	Developmental Delay w/ spastiticy, equilibrium disorder & Hirschsprung Disease	12.5 ms	5 ms	20 ms	5.5 ms	17	6
Hugh	Down's Syndrome	6.5 ms	----	9 ms	-----	8	5
Juliet	Down's Syndrome	4.0 ms	2.5 ms	12 ms	10 ms	15	8

Both pulling the string attached around the wrist and kicking were monitored for each child. In addition, visual attention to the manipulands and/or the consequence, smiling, vocalizing, crying, general arousal, and distraction were recorded. For the present study we will focus upon kicking and pulling as components of the multiple baseline design. Both manipulands were continuously available for each child although only one produced a consequence when moved.

After the child had achieved a stable rate of responding on the operative response which was consistently higher than the rate of responding on the inoperative response, the contingencies were reversed. After this reversal the previously inoperative response produced the consequence while the previously operative response produced no consequence. If the child did not reach a stable response rate on the contingent response the contingencies were reversed after fifteen sessions.

RESULTS

Results are presented graphically for representative sessions for each child. Both the arm and leg responses are depicted on each graph. One would predict that the reinforced response would be consistently higher than the non-reinforced response and that the curves would reverse when the contingencies of reinforcement reversed.

Two of the Down's syndrome children (Jennifer and Rosa) age 4 and 6 months showed immediate differentiation of the reinforced from the nonreinforced response. Baseline and initial acquisition sessions for the arm pulling response are presented in Figure 1. After several sessions with the same contingencies the behavioral control which had been evident in these early sessions began to deteriorate as evident in Figure 2. This could reflect a general habituation to repeated sessions involving the same reinforcement. It is interesting to

note in Rosa 6/4 that the curves during the first seven minutes are nearly mirror images of one another. Since at this point Rosa has experienced reinforcement for both pulling and kicking such a pattern may reflect an exploratory strategy.

The other two Down's children (Hugh, age 6 months and Juliet, age 3 months) did not acquire kicking in the same rapid and clear fashion as Rosa and Jennifer. Sessions representative of Juliet's pattern of acquisition are shown in Figure 3. Juliet 5/15 demonstrated a general increase in both responses. Such a pattern would be characteristic of a primary circular reaction in which the consequence causes a general arousal which causes another consequence. The leg response begins to be differentiated from the arm response in Juliet leg 5/21 with a greater relative proportion of kicking rather than pulling. In Juliet 5/23 this differentiation become more pronounced and is evident from the first minutes of the session. In Juliet 6/5 it appears that the contingent response must be discovered anew. However, by Juliet 6/10 the leg response is clearly maintained at a higher rate than the arm response. During the first arm contingency (Juliet 6/27) the acquisition of the pulling response is clear and rapid. However, even in this session the curves rise and fall together indicating the working of a general arousal mechanism as opposed to clear differentiation of separately organized responses.

Hugh also showed a slow differentiation of the reinforced from the non-reinforced response, as depicted in Figure 4. At 6 months of age, however, the relationship between the two responses does not seem to reflect a primary circular reaction (Hugh 5/13). One can see an acceleration of the kicking response in 5/13 which is replicated in 5/16 along with a gradual deceleration of arm pulling. This acceleration of the kicking response is evident in 5/29 but no differentiation between the reinforced and nonreinforced response. In Hugh 6/6 there is the first evidence of clear differentiation of the two responses. It is interesting to note

for this child the fact that memory does not appear to be leading to progressively better performance. The influence of the contingencies develop within a session. However, for Hugh 6/17 the pulling response is maintained at a higher rate than the kicking response when the pulling produces a consequence.

Troy, age 13 months, did not differentiate the pulling from the kicking response during contingencies for either type. Troy 3/5 is typical of Troy's sustained high rate of behavior with little indication of learning which response operated the reinforcement.

DISCUSSION

The results suggest that handicapped children under one year of age can learn through simple contingencies of reinforcement. However, the patterns of acquisition appear to be somewhat different for different children. Jennifer and Rosa appeared to differentiate the reinforced response from the nonreinforced response very rapidly. Since these two children learned the pulling response first, this rapid differentiation may reflect a difference in "preparedness" of the arm response relative to the leg response (Seligman, 1970). The rapid learning of the arm response in comparison to the leg response by Hugh and Juliet would add some support to the notion that this response was more salient.

A question raised by the data generated after the first indication of learning is whether we should expect the same patterns of responding to persist over time given the same contingency. The Lewis and Goldberg (1969) model would lead to the prediction that after a child has formed an expectancy, only periodic confirmation of the contingency would be necessary. The decrease after extended conditioning would be accounted for by habituation to the contingency of reinforcement and the concomitant reduction in reinforcement value of the redundant feedback. Thus, the infant becomes satiated to the redundant information provided within

a contingency of reinforcement which has been functioning for some time. This interpretation is supported by the data from Jennifer and Rosa after repeated exposure to a contingency of reinforcement.

A final point concerns the difference in acquisition of arm versus leg movements within these contingencies of reinforcement. All of the children showed rapid differentiation of the reinforced pulling response from the nonreinforced kicking response. However, the reinforced kicking response showed rapid differentiation only for the two children who learned the arm response first (Jennifer and Rosa). When presented with a contingency of reinforcement for kicking both children showed immediate and clear differentiation of the leg movement from the arm movement. This data suggests that the establishment of the generalized expectancy of control over the environment is more efficient if one begins with contingencies for movements which are most "prepared" for the individual child.

In conclusion, the data demonstrate that Down's syndrome infants do learn within a simple operant conditioning paradigm. However, the patterns of acquisition depend both on the salience of the operative response and upon previous learning experience.

References

Affleck, G. G. Physicians' attitudes toward discretionary medical treatment of Down's Syndrome infants. Mental Retardation, 1980, 18(2), 79-81.

Brassell, W. R. & Kaye, H. Reinforcement from the sucking environment and subsequent modification of sucking behavior in human neonates. Journal of Experimental Child Psychology, 1974, 18, 448-463.

Caron, R. F. & Caron, A. J., & Caldwell, A. C. Satiation of visual reinforcement in young infants. Developmental Psychology, 1971, 5, 279-289.

Lewis, M. & Coates, D. L. Mother-infant interactions and cognitive development in twelve week old infants. Infant Behavior and Development, 1980, 3, 95-105.

Lewis, M. & Goldberg, S. Perceptual-cognitive development in infancy: A generalized expectancy model as a function of the mother-infant interaction. Merrill-Palmer Quarterly, 1969, 15(1), 81-100.

Millar, W. S. A study of operant conditioning under delayed reinforcement in early infancy. Mongraphs of the Society for Research in Child Development, Serial No. 147, 37(2), 1972.

Robinson, C. & Robinson, J. Sensorimotor functions and cognitive development. In M. Snell (Ed.) Systematic instruction of the moderately and severely handicapped. Columbus, Charles E. Merrill, 1978.

Rovee, C. K. & Fagan, J. W. Extended conditioning and 24 hour retention in infants. Journal of Experimental Child Psychology, 1976, 21, 1-11.

Seligman, M. E. P. On the generality of laws of learning. Psychological Review. 1970, 77, 406-418.

Sheppard, W. C. Operant control of infant vocal and motor behavior. Journal of Experimental Child Psychology, 1969, 7, 36-51.

Sidman, M. Tactics of Scientific Research, New York: Basic Books, 1960.

Siqueland, E. R. Reinforcement patterns and extinction in human newborns. Journal of Experimental Child Psychology, 1968, 6, 431-442.

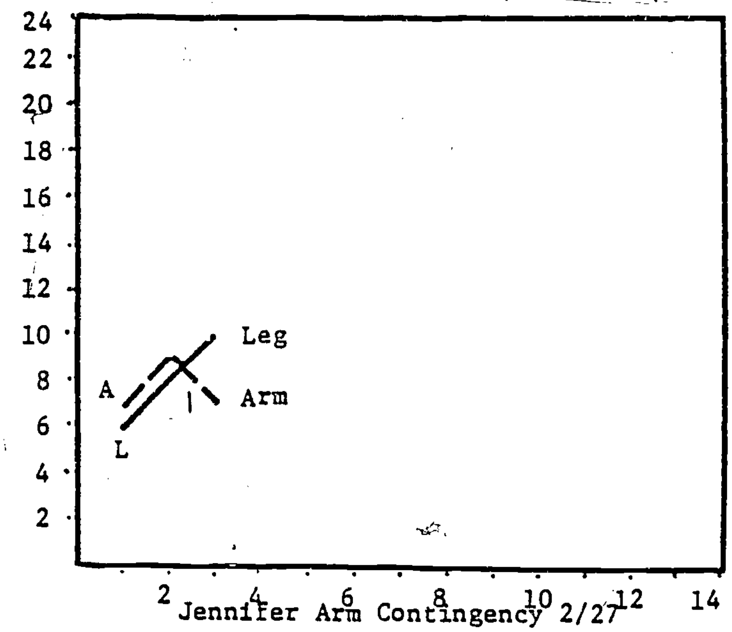
Switzky, H. Rotatori, A. F., Miller, T., Freagon, S. The developmental model and its implications for assessment and instruction for the severely/profoundly handicapped. Mental Retardation, 1979, 17(4), 167-170.

Watson, J. S. The development and generalization of contingency awareness in early infancy: Some hypotheses. Merrill-Palmer Quarterly, 1966, 12, 123-135.

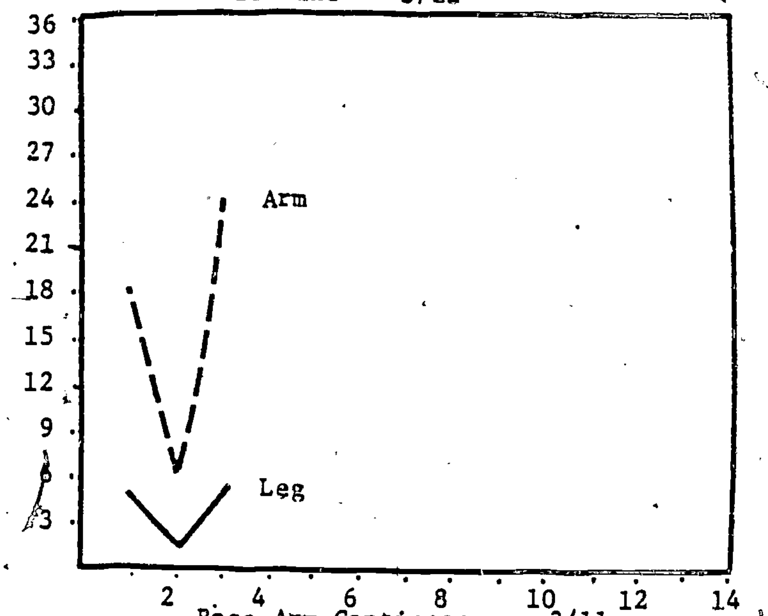
Watson, J. S., Hayes, L. A. & Vietze, P. Response-contingent stimulation as a treatment for developmental failure in infancy.

Watson, J. S. & Ramey, C. T. Reactions to response-contingent stimulation in early infancy. Merrill-Palmer Quarterly, 1972, 18, 219-227.

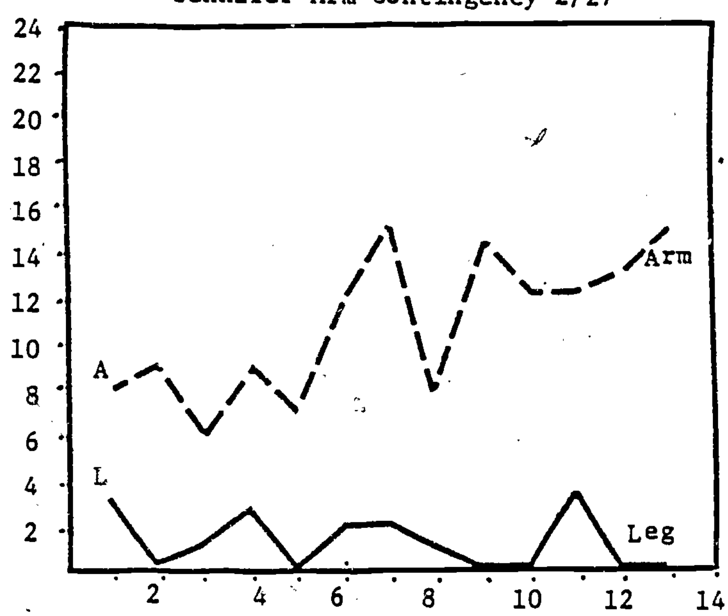
Jennifer Baseline 2/27



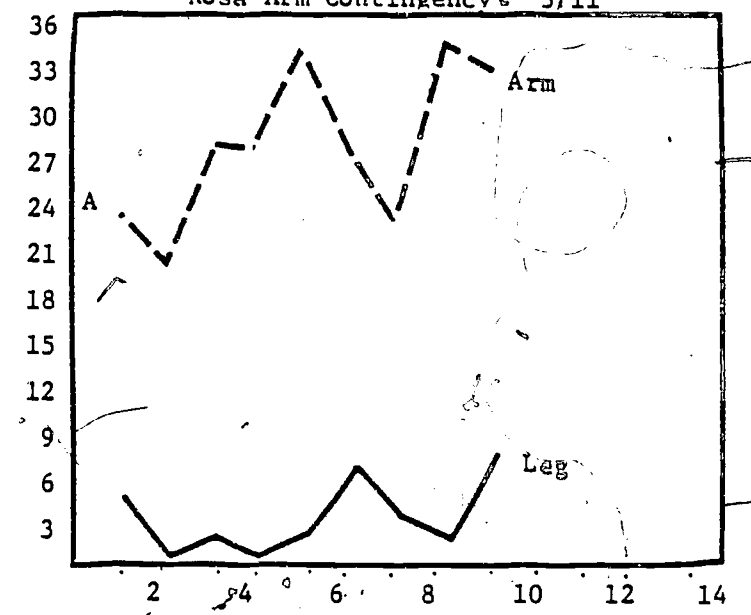
Rosa Baseline 3/11



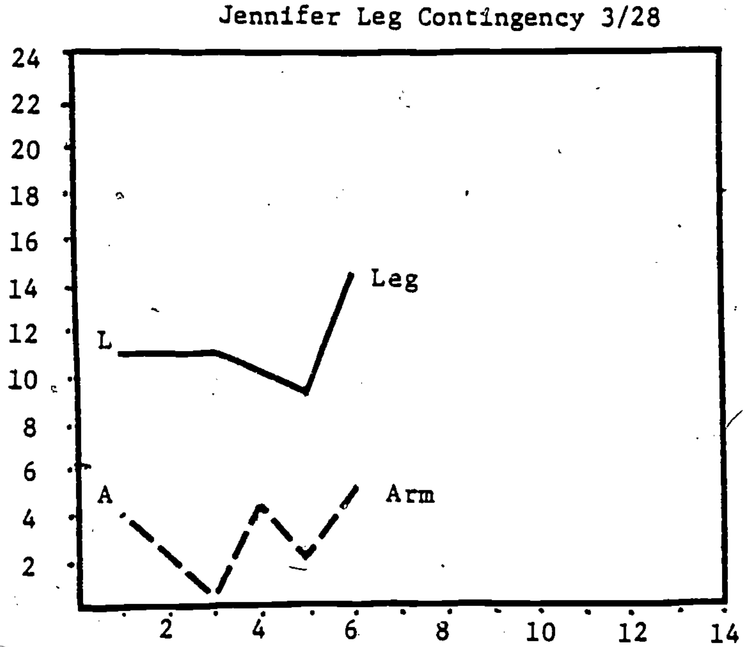
Jennifer Arm Contingency 2/27



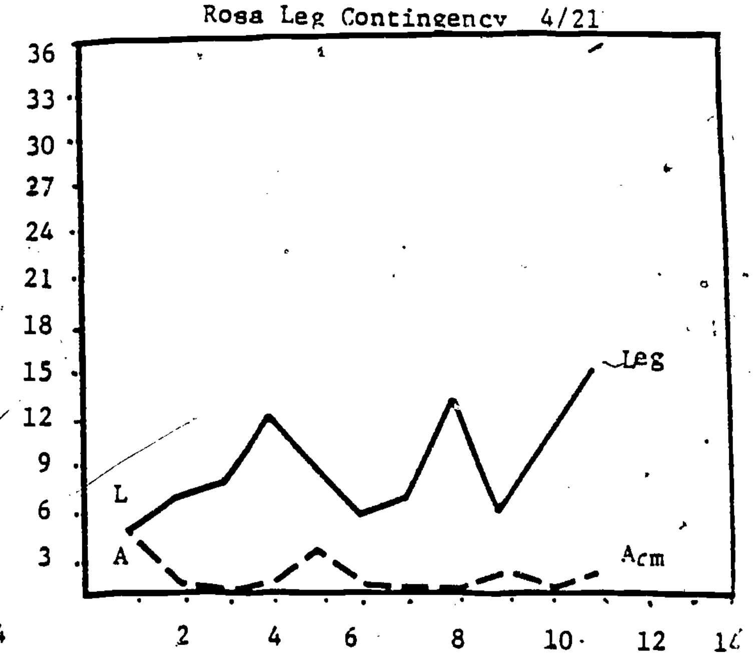
Rosa Arm Contingency 3/11



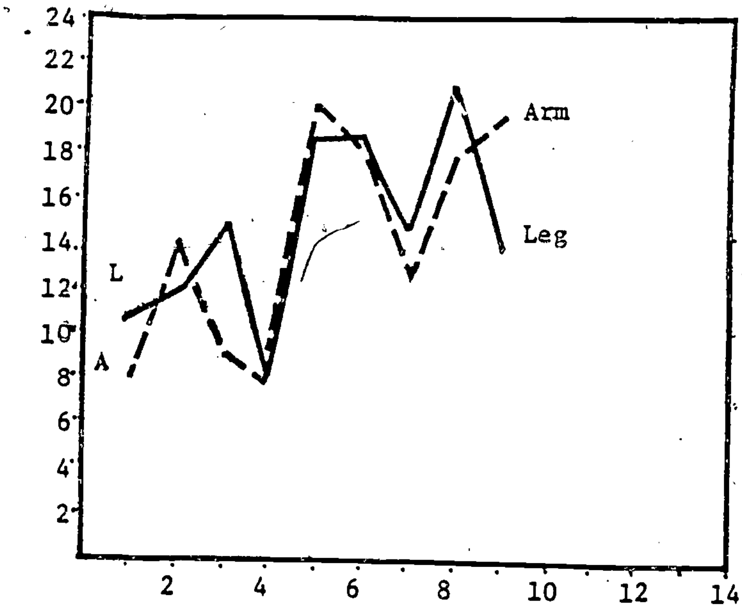
Jennifer Leg Contingency 3/28



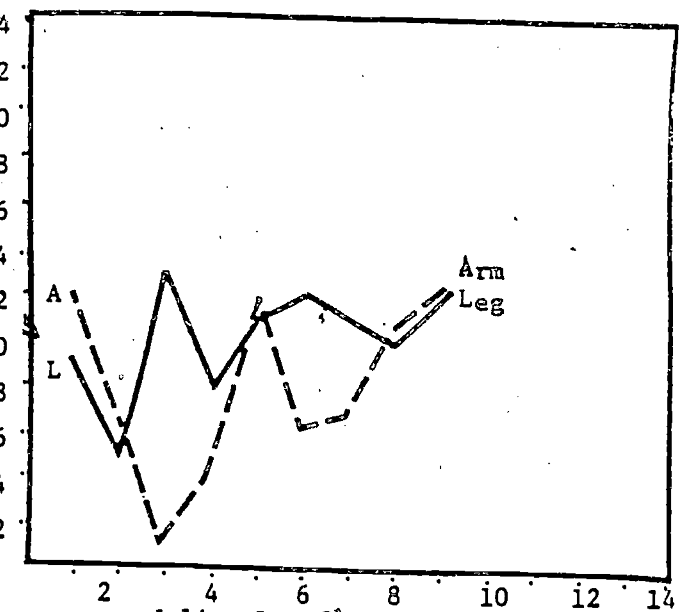
Rosa Leg Contingency 4/21



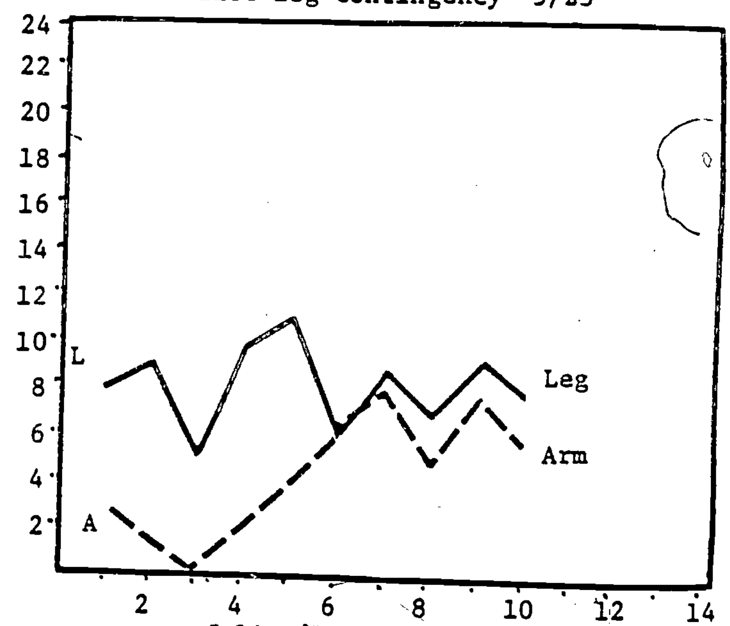
Juliet Leg Contingency 5/15



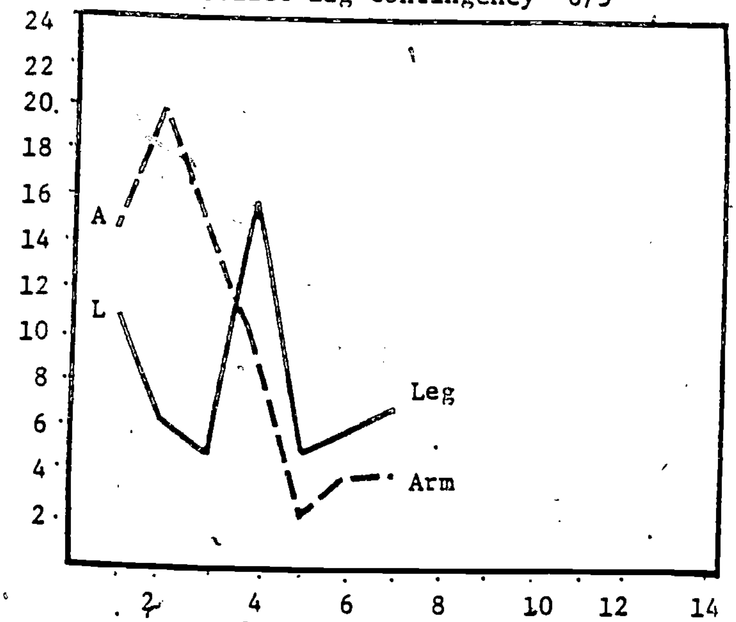
Juliet Leg Contingency 5/21



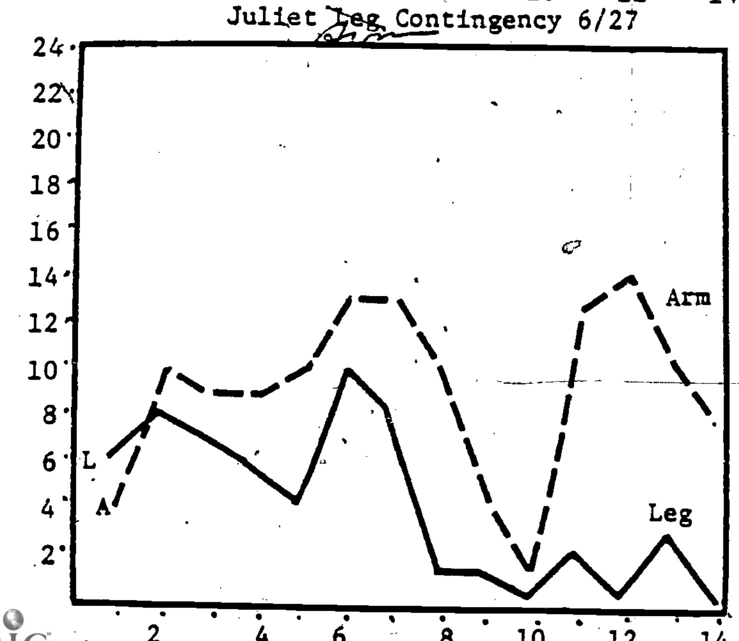
Juliet Leg Contingency 5/23



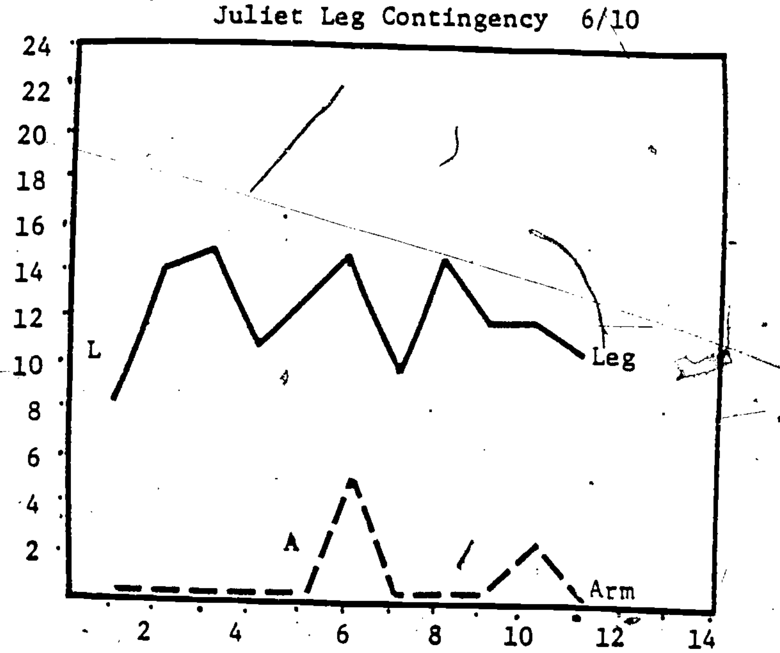
Juliet Leg Contingency 6/5

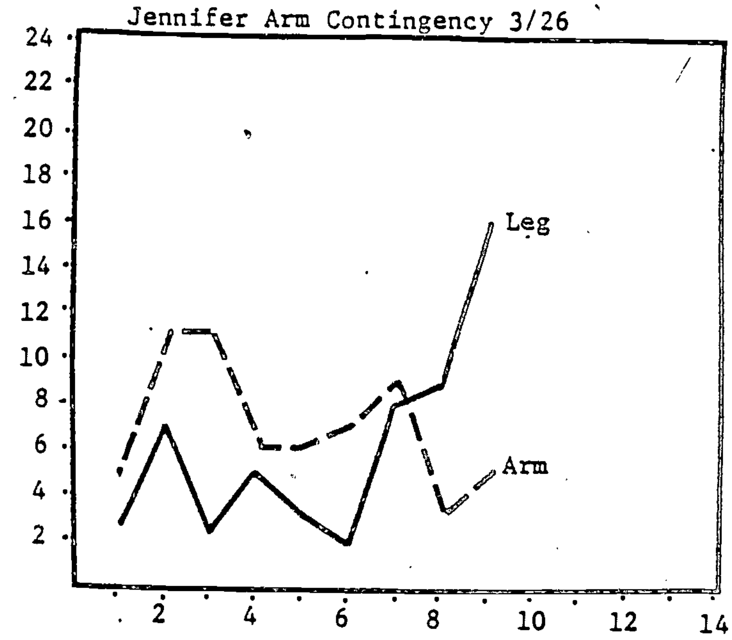


Juliet Leg Contingency 6/27



Juliet Leg Contingency 6/10




Jennifer Arm Contingency 3/26
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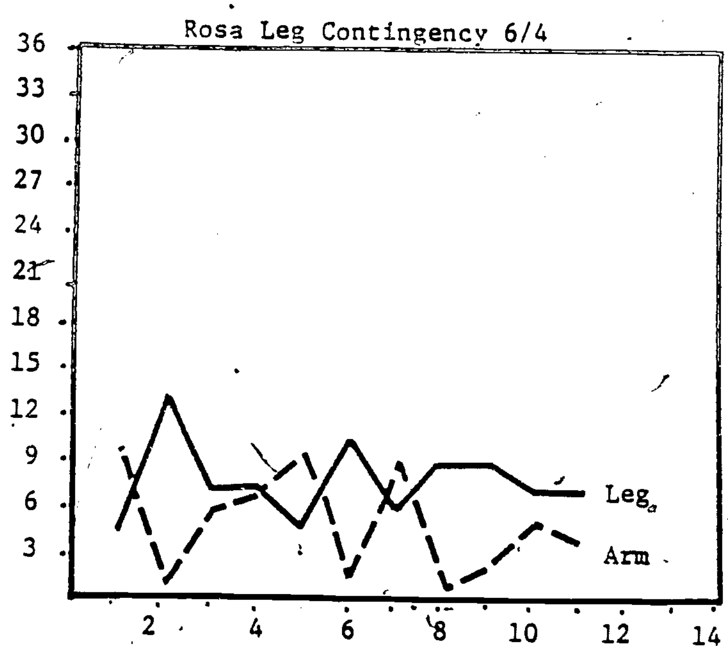
Rosa Leg Contingency 6/4
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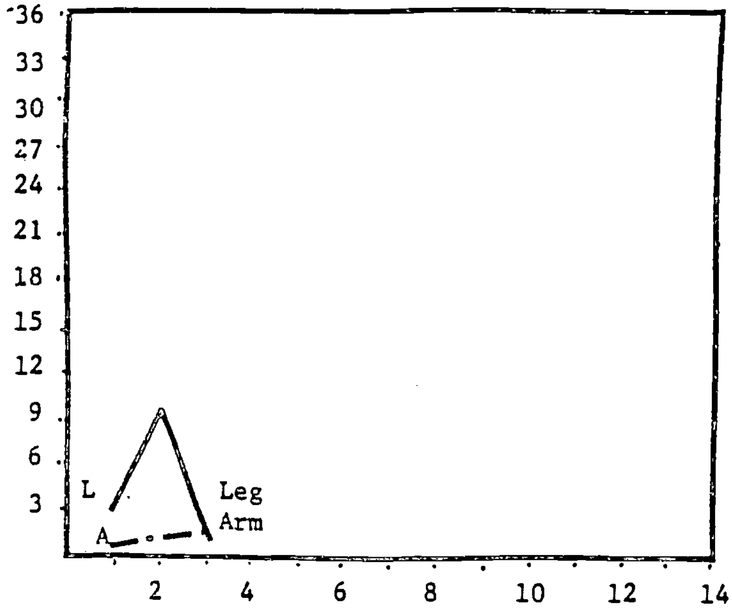
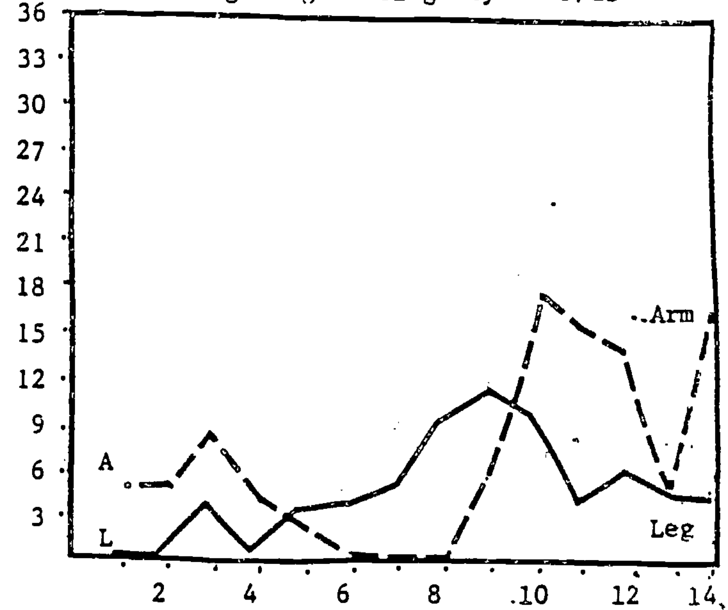
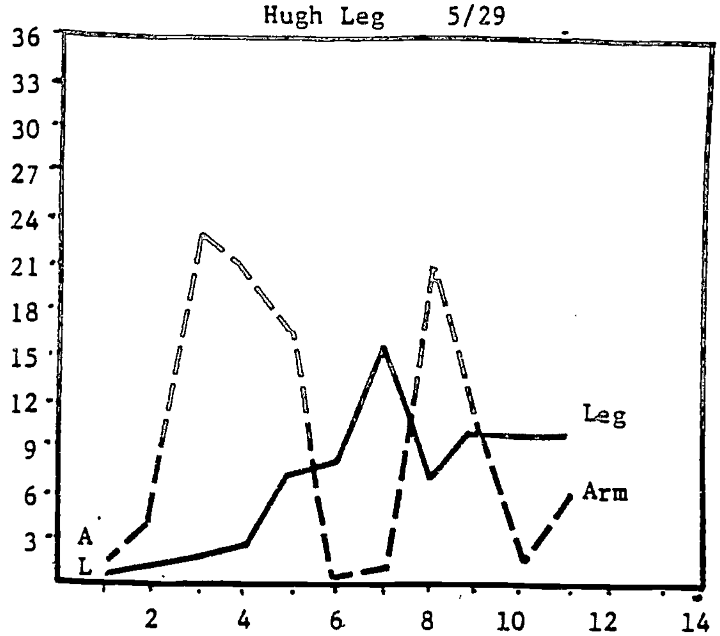
Hugh Baseline 5/13



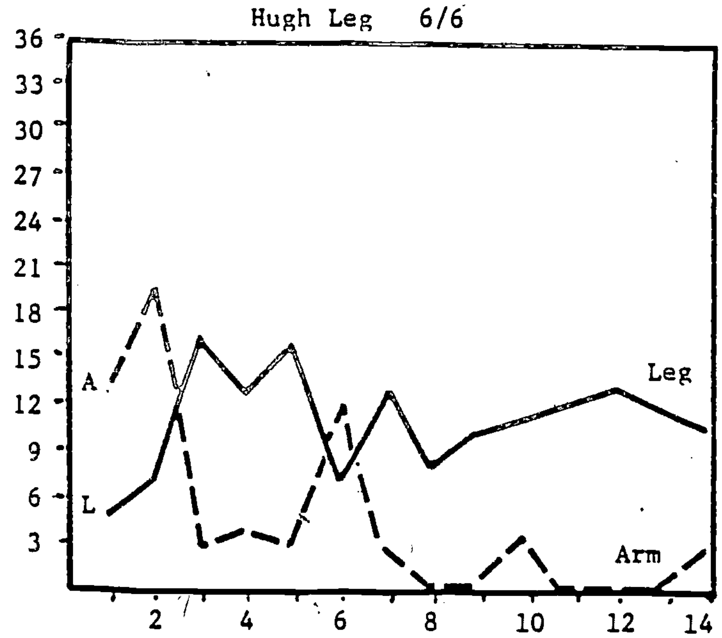
Hugh Leg Contingency 5/13



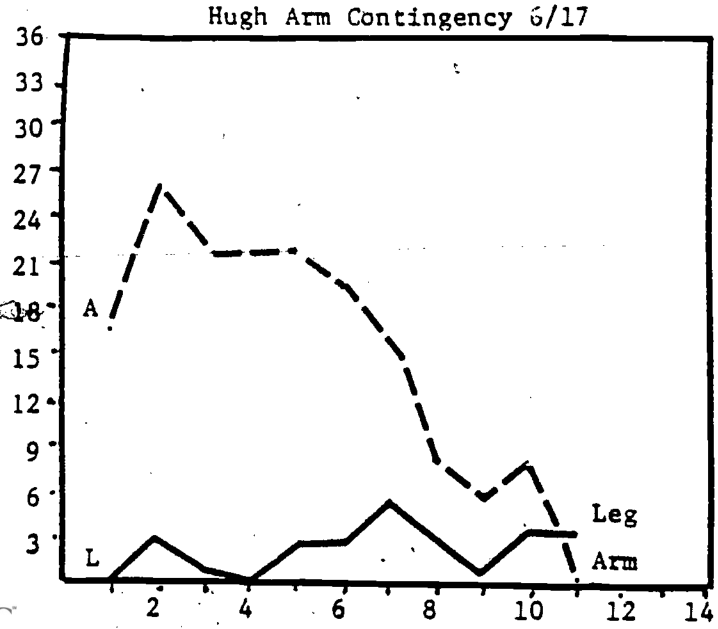
Hugh Leg 5/29



Hugh Leg 6/6



Hugh Arm Contingency 6/17



Troy Leg Contingency 3/5